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(54) Raising liquids; dredging apparatus

(57) For the dredging of soundings of difficult or dangerous access, the known submersed pump has the inlet ducts of the pumping chambers 22 are connected to only one hose 32 of adjustable length. The hose 32 has a dredging shovel 28 or suction head 130 at its outer end. The pump is preferably as described in specification 1390982. Preferably the dredging shovel has a screening grid across its opening, and may be manoeuvred relative to a pontoon 26 by an arrangement of arms and ropes and capstans.

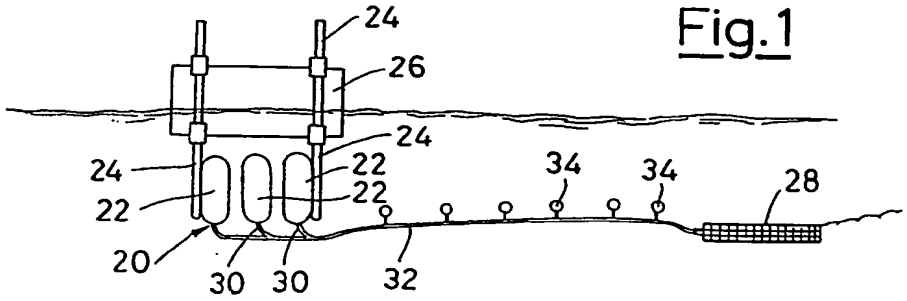

Fig.1

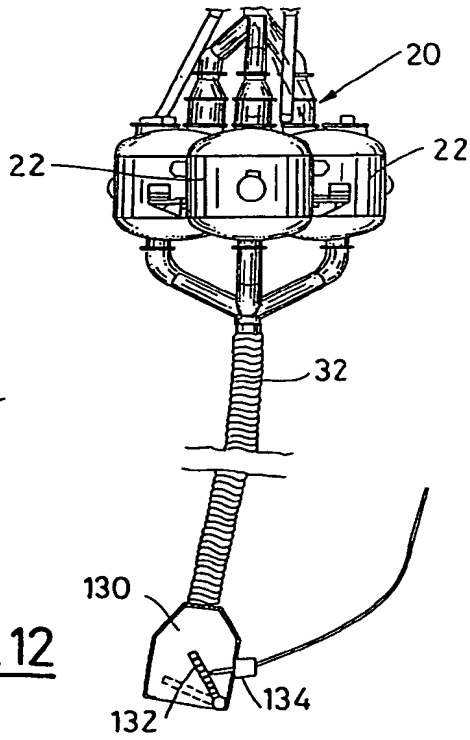

Fig.12

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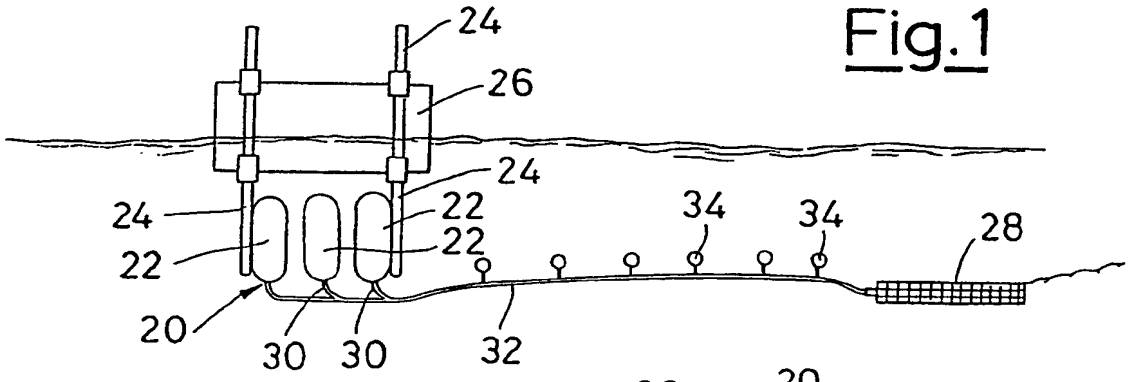
Fig.1



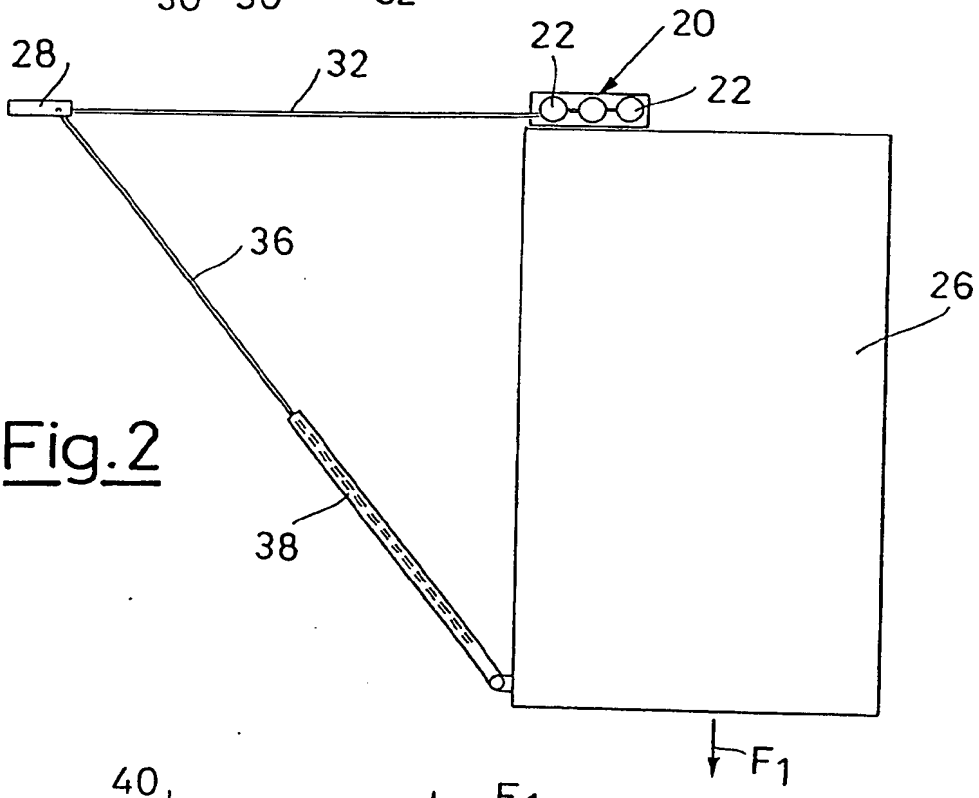


Fig.2

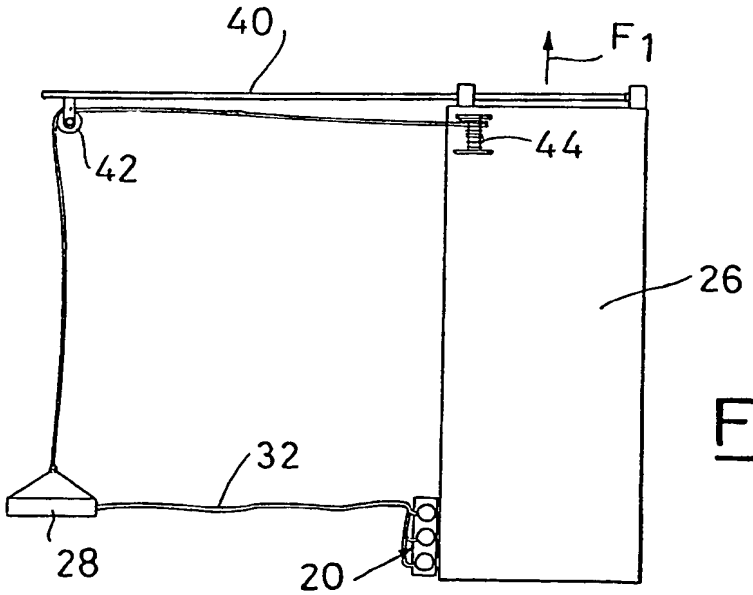


Fig.3

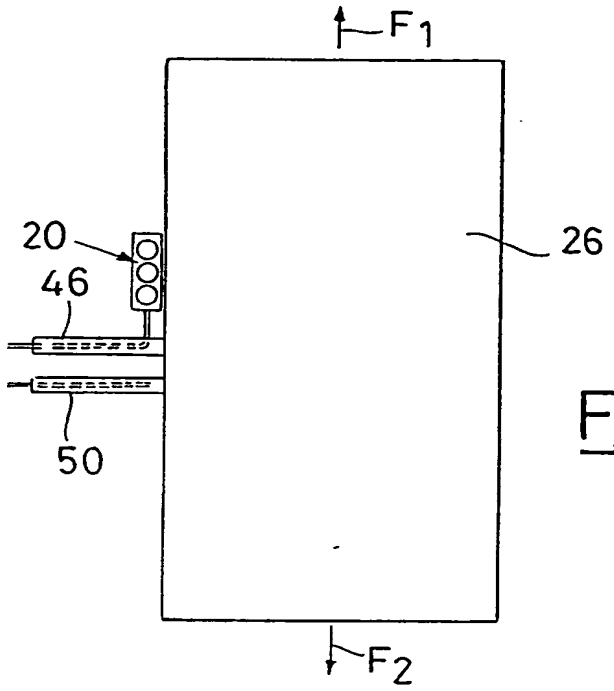


Fig. 4

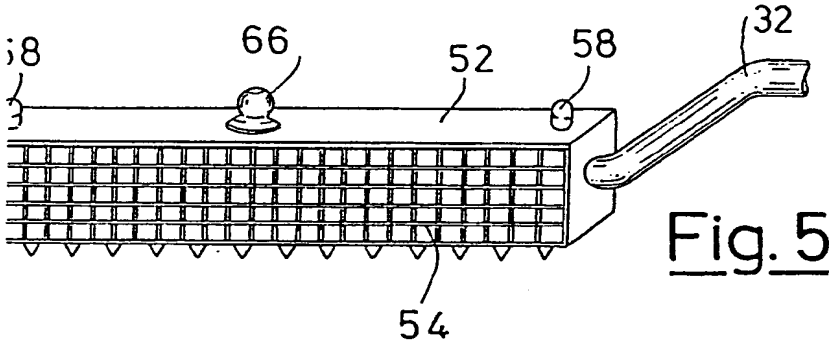


Fig. 5

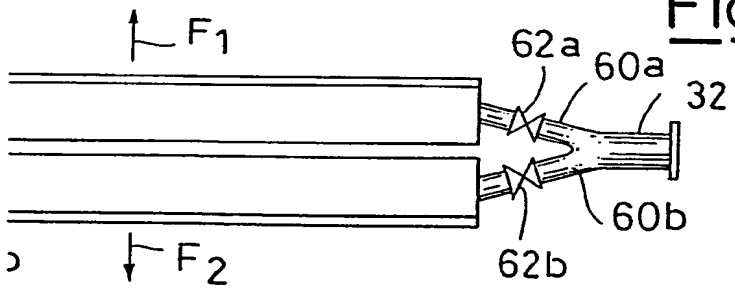


Fig. 6

Fig. 7a

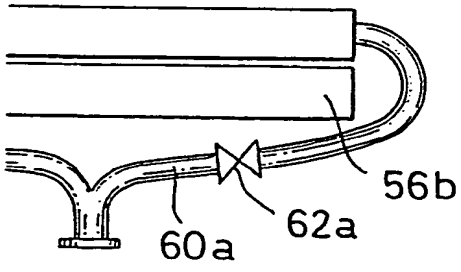
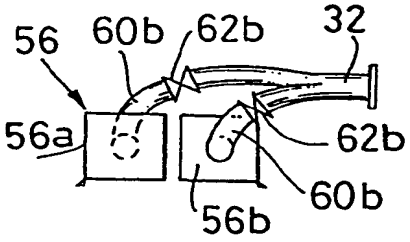


Fig. 7b



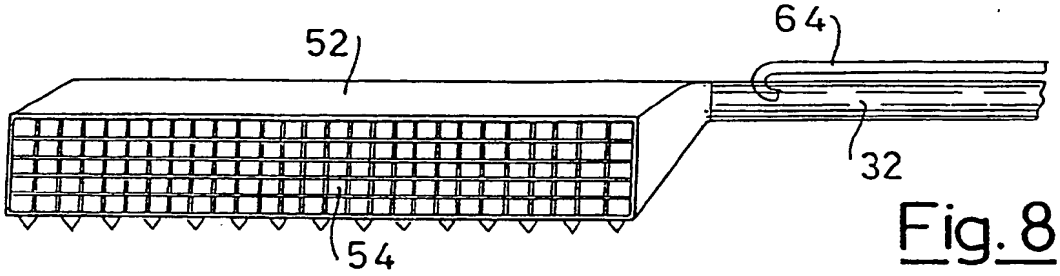


Fig.8

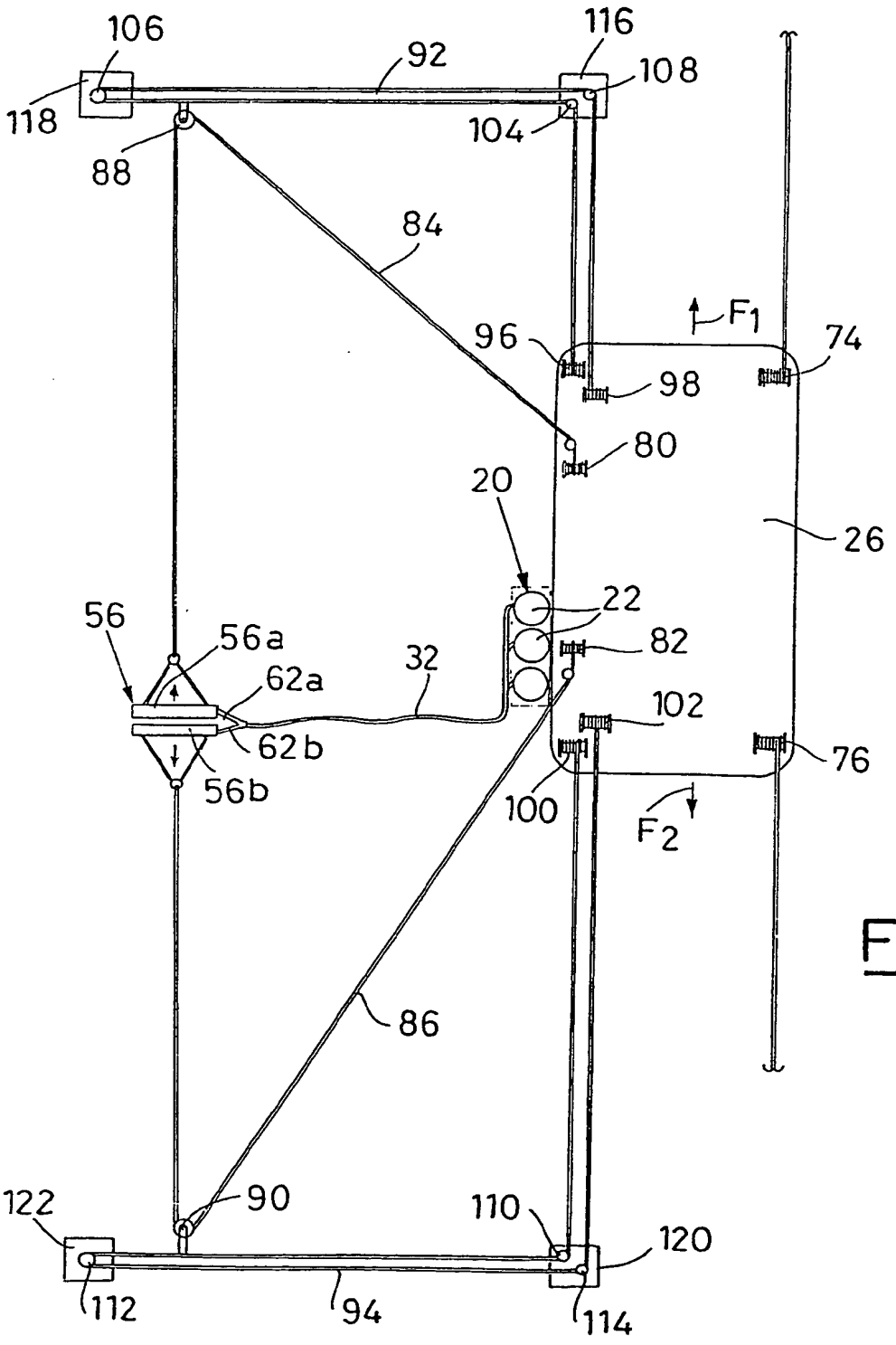


Fig.10

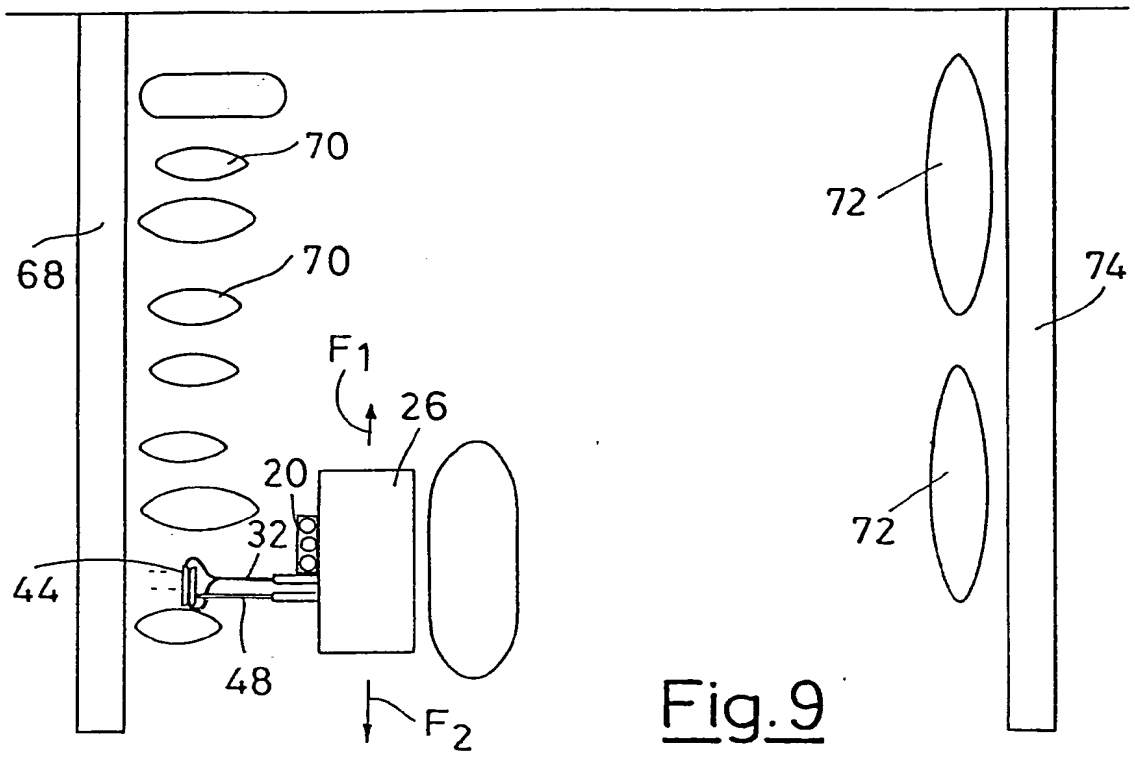


Fig.9

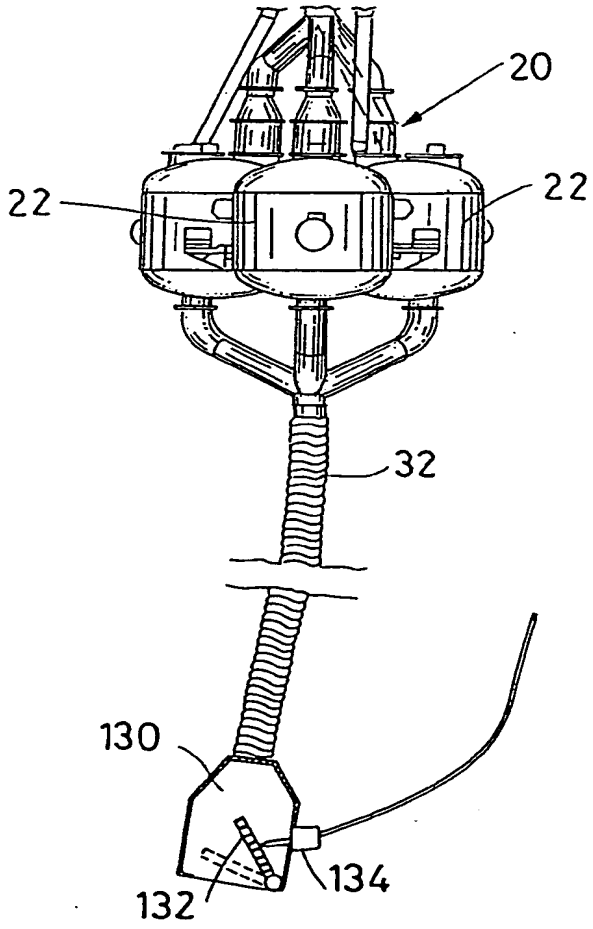


Fig.12

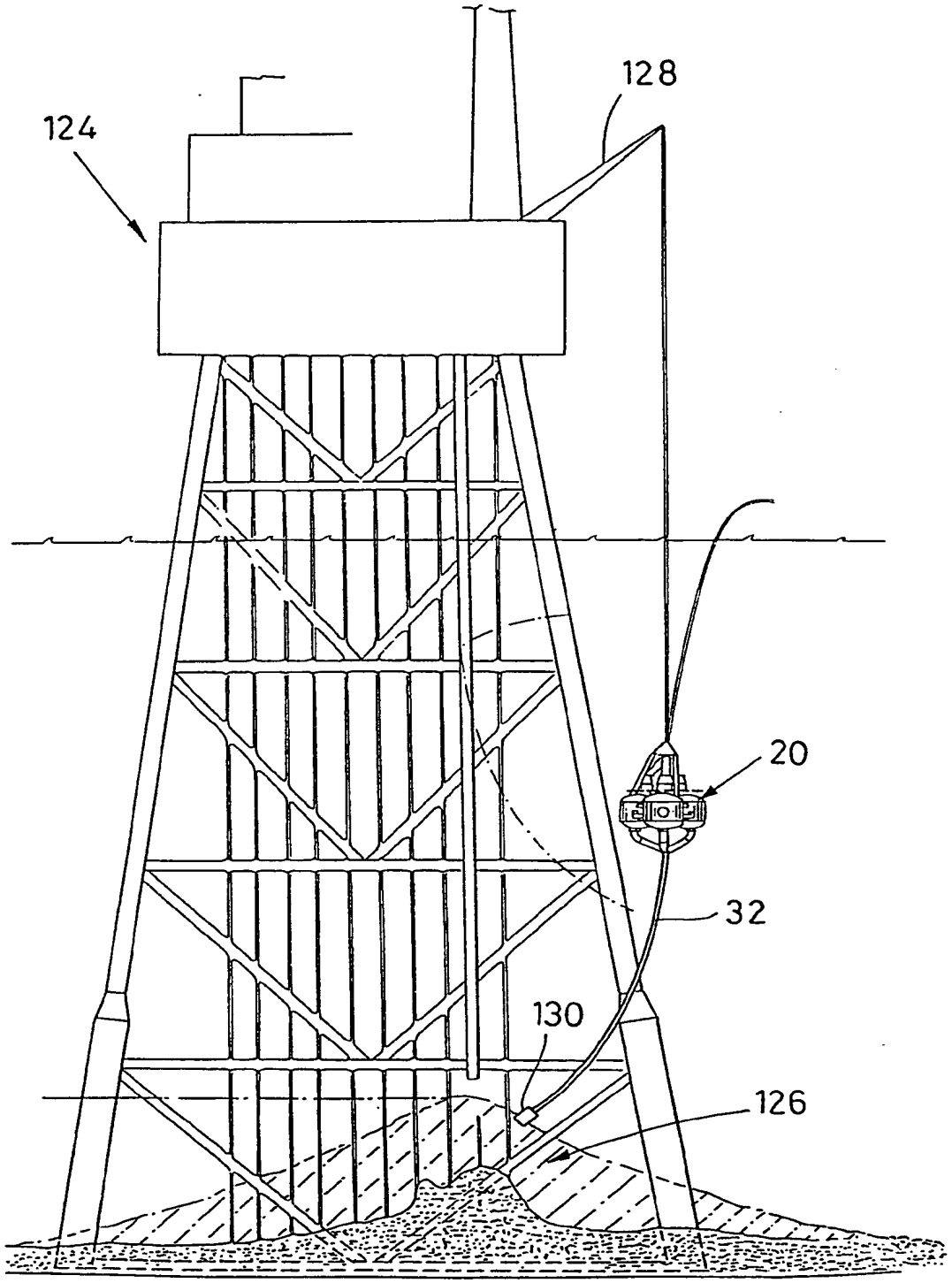


Fig.11

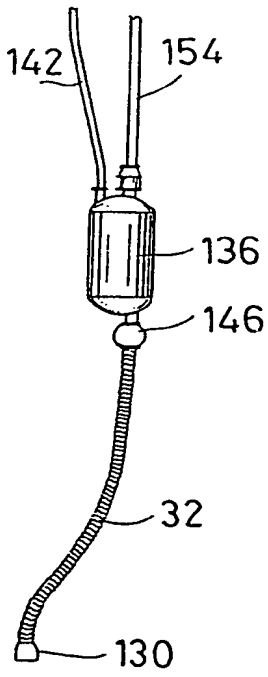


Fig.14

Fig.13

Dredging apparatus

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The present invention relates to dredging apparatus and more particularly to an improved dredging apparatus useful for the dredging of submersed areas, possibly very deep, the access to which may be difficult and/or dangerous.

Examples of the areas above referred to are the harbour soundings, wherein the dredging is to be carried out while boats or vessels are anchored, the soundings under offshore oil drilling platforms, sealines laid down onto the marine depths, piers either floating or laid onto pillars, river bridges of limited height, discharging outlets of dams etc.

Dredging plants are known operating with compressed air and generally mounted onto a watercraft, the dredging plant generally comprising:

1) A submersed pump body, consisting of two or more cylindrical chambers, having an inlet valve at the bottom, this valve being connected to a dredging shovel or paddle or to a vertical sucking pipe, a delivery or discharge pipe provided with a check valve the inlet of the latter pipe being positioned in the upper part of each cylindrical chamber and a connecting fitting with a pipe conveying within each cylindrical chamber compressed air and permitting the discharge thereof to the atmosphere;

2) an air distributor controlling the inflow and the outflow of air with respect to each cylindrical chamber of the pump body by means of suitable connecting pipes;

3) a source of compressed air normally consisting of an air compressor;

4) a liquid delivery pipe connected to the delivery or discharge pipes of the single cylindrical chambers, downstream of the related check valves.

The liquid mixture consisting of water and of the dredged solid material fills, through the inlet valve, the cylindrical chamber owing to the counterpressure generated by the water level above the submersed pump.

Upon the cylindrical chamber is filled , air pressure is fed thereinto, it coming from the air compressor through the air distributor and acting as a piston. Consequently the liquid mixture present within the cylindrical chamber closes the lower inlet valve and flows, through the upper check valve to the delivery or discharge pipe.

The air operating in a cylindrical chamber, upon the liquid mixture is discharged, is exhausted to the atmosphere whilst the same cycle is taking place in another pumping chamber of the pumping body.

An advantageous feature of these plants, in which rotating mechanisms in contact with the soundings are absent, is that of avoiding any secondary pollution if the dredging is

carried out in polluted soundings.

Moreover, owing to the relevant flow rate of the liquid entering the cylindrical chambers, which is directly proportional to the hydrostatic load, high solid percentages in the dredged and pumped mixture are ensured.

Another feature of these dredging plants is that the pumping body can be connected to inlets or dredging shovels or paddles of several types, the choice of which is made depending on the dredging operation to be carried out and on the characteristics of the soundings to be dredged, a firm and rigid connection to the cylinders forming the pumping body being always ensured

For a more comprehensive and detailed information about these pumps and the related distributor of compressed air reference is made to U.K Patent Specification No.1,390,982 and to the Australian Patent Specification No.495,637,which are herien incorporated by reference.

As regards the dredging operation per se, it normally comprises the towing of the dredging shovel together with the submersed pumping body along parallel stripes of the soundings to be dredged with a to-and-fro motion.

This operating method is however not applicable is some cases, such as for instance harbour areas in which boats or vessels may be anchored, oil drilling platforms comprising supporting structures and oil extracting pipes giving place to a relevant encumbrance and the other cases above referred to, since the pumping body cannot be operated in the above mentioned manned either owing to lack of enough room and/or owing to the risks connected to the closeness of a heavy and high size apparatus, namely the pumping body with the dredging shovel with respect to valuable and sophisticated items, like the anchored boats or the underwater structures of the oil drilling platforms.

The main purpose of the present invention is that of providing a dredging apparatus permitting the above mentiond problems to be solved and at the same time the above mentioned submersed compressed air pumps to be used.

According to the present invention the inlet valves of the cylindrical chambers forming the submersed pumping body are connected to a first end of at least one inlet dredging hose of adjustably variable length, the other end of the dredging hose being provided with a suction mouth or a dredging head possibly having means for the remote adjustement of the width thereof and consequently of the suction area.

The said suction mouth or dredging head shall be selected as regards either the area and/or the shape thereof depending on the type of material to be dredged, the size thereof and the depth at which the dredging has to be effected.

According to a first embodiment, referred to the dredging operation carried out on

polluted muddy soundings of harbour areas wherein boats and vessels are present, or under piers or bridges, the suction head shall be preferably connected to a metal conveying shovel the inlet or mouth of which shall be properly shaped and provided with a grid preventing coarse pieces form entering the suction head, the shovel being of extended shape in order to be able to carry out the dredging operation on a sufficiently wide strip. Such a shovel is guided and dragged on the sounding so as to permit the collection of the deposited muds present onto the sounding under the vessels, the pumping body being maintained in a submersed condition and supported by a pontoon or like means, enough spaced from the area occupied from the vessels or boats anchored to the piers, whereby the dredging of areas somewhat remote from the pumping body is made possible.

The displacement of the pumping body can be effected in a number of ways:for example by means of a pontoon to which the pumping body is connected so as to be either dragged or pushed along the central zone between two piers or anyhow in an area not occupied by docked watercrafts, which area has to be dredged as the first one in order to submerge the pumping body at the maximum possible depth during the dredging under docked vessels. Otherwise the pontoon displacement can be effected by means of a crane supporting the pumping body from the pier or by means of cradles or wheeled systems permitting the dragging thereof along the sounding or even by means of oscillating arm systems of the type already known for suction dredging apparatus.

For illustrating purposes the simple application of the pumping body to a buoyant pontoon can be described the pontoon being displaced parallelly to the dock in an area devoid of watercrafts and already dredged.

In this case the pumping body can be mounted abaft and supported by a crane or derrick with steel ropes or preferably by means of one or more vertical telescopic arms controlling both the submersing depth and the vertical condition thereof.

The suction pipe can be a rubber hose connected to the suction shovel provided with a steel grid and the displacement thereof can be effected by means of a horizontal telescopic arm capable of being inclined in a variable manner both vertically and horizontally hinged at the bow, so as to permit the displacement thereof at the desired depth and distance.

This suction hose can be also formed by a number of connectable segments having same length as that of the suction grid shovel whereby it is possible to effect a first dredging stroke parallelly to the pier in the closest position with respect to the pontoon and, upon the pontoon is returned to the starting position, a second dredging stroke after having added a second segment of hose permitting the dredging of another strip having same

width as the suction grid shovel in an area closer to the pier.

The shovel displacement can also take place by means of an horizontal rigid or preferably telescopic arm, having adjustable inclination both vertically and horizontally, mounted at the bow and connected to the shovel either by being directly hinged thereto or by means of connecting ropes.

As a further example of the pump displacement system of a more sophisticated nature, although permitting a ready control and motion, it can be formed by a pontoon to a side of which in a center position the pumping body is connected by means of vertical telescopic pipes or arms, whereas the connection hose can be of telescopic type to permit an easier adjustment of its length.

In this case the dredging strokes, always parallel to each other, may take place from the area closest to the pier towards the pontoon and viceversa.

The suction grid shovel can be of double type, and thus with opposed suction inlets, having a hydraulically, oleodynamically or pneumatically controlled gate valve permitting the closure of the suction inlet which is not directed in the advancing direction of the shovel.

In this case, by which dead times are done away with, the pontoon should be provided with a horizontal telescopic arm, the inclination of which is both horizontally and vertically variable, so as to adjust the depth, the advancing and the displacement of the shovel.

As regards the mud suction shovel, it should have a height corresponding to the thickness of the material to be removed by each dredging stroke, the width thereof being such as to provide a solid content, which shall be dependent on the flow rate of mixture of the pump and on the advancing rate, the latter being anyhow very low to prevent the soundings from being stirred and therefor to avoid a dispersion of polluted muddy material which would lead to a secondary pollution.

This shovel, as already mentioned hereinbefore, shall be completed by a cutting steel grid permitting the penetration thereof within the sounding material, but simultaneously preventing foreign bodies 9of too great size from entering thereinto, whereby it has an elongated shape with cutting edges.

As regards the easy conveying of muddy materials present on the soundings from the dredging shovel to the pumping body even at a relatively high distance, it is to be taken into account that in the compressed air pumps of this type, in which the filling of the cylindrical chambers is based on the level difference between the water surface and the submersed pumping body, owing to the well known formula $v = \sqrt{2gh}$, the inlet flow rate at a depth of the pumping body of 3 meters is 7.7 m/s, definitely higher than that of

centrifugal pumps and anyhow such as to ensure the conveying of even dense mixtures.
It is however possible, in the case of high distances between the dredging shovel and the pump body, either dilute the mixture or make the conveying thereof easier in the hose connecting the suction shovel with the cylindrical chambers of the pumping body by injecting water by means of high pressure pumps and by using pipes with nozzles directed in the advancing direction of the dredged mixture towards the pumping body.
It is furthermore possible to combine the air outlet of the air distributor with one or more Venturi sections fed with compressed air or a vacuum pump so as to induce a vacuum condition by which the inlet flow rate of the dredged mixture within the pumping chambers is increased and consequently the conveying along the above stated connecting hose takes place in an easier manner.
The invention shall be better understood from the enclosed drawings, showing for illustrative but non limiting purpose, the main features of the invention. In the drawings:
fig.1 is a schematic front view of the pontoon supporting the pumping body according to a first embodiment;
fig.2 illustrates an example of connection between the pumping body and the displaceable suction head;
fig.3 is a plan view of another embodiment of the operating connection between the pontoon and the pumping body;
fig.4 is a plan view of an embodiment as regards the positioning of the double suction head;
fig.5 is an elevation view of a suction grid shovel;
figs.6, 7a and 7b, are plan view of embodiments of the double suction shovel;
fig.8 is a front view of another embodiment of the suction shovel;
fig.9 shows an example of dredging operation within a harbour;
fig.10 is a schematic view of another dredging operation;
fig.11 is a schematic view of the dredging operation in the case of an oil drilling platform;
fig. 12 is a view of the pumping body with the connecting hose and the suction head;
fig.13 is a schematic view of the embodiment of the present invention in the case of dredging of very deep areas,and
fig.14 is a view of a modification of the embodiment of fig.13.
Turning now to the drawings,in the embodiment shown in fig.1 the submersed pumping body 20, comprising the cylindrical chambers 22, is mounted to the vertical telescopic arms 24 by which the pumping body is supported and vertically adjusted. The arms 24 are in turn mounted to the pontoon or watercraft 26, and the pumping chambers 22 are connected to the dredging shovel 28 by means of single connecting lengths 30 and the

common connecting hose, which as already stated may be either a rubber hose, or a hose formed by several hose lengths joined to each other or a flexible telescopic pipe.The hose 32 may be possibly provided with buoyancy elements 34 by which the hose 32 is maintained in a position spaced from the soundings being dredged and consequently there is no possibility of disturbing the polluted muddy material to be removed.

It is to be noticed that both the pumping body and the other components of the plant are illustrated in a rather schematic manner since they are per se well known in the art since a number of years. For instance the submersed pumps referred to in this specification have been manufactured and used for dredging plants in the sixties and seventies under the trade name "Pneuma pumps".

The plant shown in fig. 2 comprises the pontoon 26, which is displaced along the direction indicated by the arrow F_1, and the pumping body 20 including the pumping cylindrical chambers 22 which are connected to the dredging shovel 28 by means of the hose 32, like that of fig.1.

The shovel 28 is telescopically connected by an arm 36 to the end of an arm 38 which can be trained both horizontally and vertically in order to adjust the position of the suction and dredging shovel 28. Consequently the arm 38 is journalled to the pontoon 26 in a per se known manner permitting the above orientation thereof.

In the embodiment of fig.3 the pontoon 26 is advanced in the direction F_1 and has the pumping body 20 mounted abaft whereas at the bow a rigid arm 40 is secured thereto supporting a pulley for the passage of a rope 44 connecting the shovel 28 to a capstan 44. The pulley 42 may be displaced along the arm 40 in an adjustable position or the arm 40 may be slidably positioned at the bow of the pontoon 26.

In the embodiment of fig.4 the pontoon or watercraft 26, is diplaceable in both directions F_1 and F_2, and has the pumping body 20 mounted sidewise and connected to the dredging shovel 44 by the hose 32 through an arm 46 which is vertically orientable; in turn the shovel 44 is of the double type, namely permitting the dredging to be effected in both directions. To this end the shovel 44 comprises two opposite suction grid inlets having internal gate valves which are alternatively closed when the shovel is dragged in the opposite direction and is connected either directly or by a rope 48 to the end of a second supporting arm 50 which can be oriented both horizontally and vertically to adjust the position of the dredging shovel 44 with respect to the soundings being dredged.

Of course the hose 32 at the remote end with respect to the pump 20 is forked to afford the suitable connection to the two operative parts of the shovel 44.

Figs.5, 6, 7a, 7b and 8, show examples of dredging shovels used in the above mentioned plants.

More particularly the dredging shovel of fig.5 comprises a case 52 the inlet opening of which is protected by the metal grid 54 and is sidewise connected to the hose 32. The reference 66 indicates the attachment in form of an eyelet flange for the connection to the end of a telescopic or orientable arm, whereas the reference 58 indicate smaller eyelets for the securing of the ends or for the passage of dragging ropes.

The shovel shown in fig.6 is a double shovel seen in plan from above, permitting the dredging operation to be carried out in both displacement directions.Each part 56 (a,b) of the shovel 56 is shaped as the shovel 56 of fig.5 and is connected to the hose 32 by a fitting 60 (a,b) comprising a gate valve 62 (a,b) which can be operated from aboard of the pontoon supporting the pumping body.

Figs.7a and 7b are a plan view and a detail view of another embodiment of the double shovel in which the same references of fig.6 have been inserted.

Fig.8 shows an embodiment of a shovel as that shown in fig.5, wherein the connecting hose 32 is provided with a side inlet pipe 64 through which water under pressure can be injected in order to promote the conveying of the dredged material, i.e. the mixture of muddy material and water entering through the dredging shovel in the case in which the length of the connecting hose 32, between the dredging shovel or the suction head and the pumping body is relevant.

Of course the inlet nozzle of the pipe 64 is oriented so as to have the stream of the water injected under pressure directed in tne same direction as the flow of dredged mixture.

Fig.9 illustrates the typical case of dredging effected in a harbour by means of a pumping body mounted sidewise with respect to the pontoon and the double shovel connected to the pumping chambers by a single telescopic horizontal pipe, the displacement and positioning of which are effected and adjusted by means of a telescopic arm pivotally connected to the pontoon and adjustably orientable both horizontally and vertically. An arrangement of this type is shown in fig.4 whereby the same reference numbers are used in fig.9.

More particularly the pontoon 26 is displaced along the directions F_1 and F_2 so as to insert the shovel 44 between and under the watercrafts 70 moored by their bows to the pier 68 as well between and under the vessels 72 moored to the pier 74 along their side (in the case of vessels of great size).

The dredged mixture is then disposed off by being discharged into the collecting boat 75.

Fig.10 illustrates the operation of the plant according to the invention in the case of a double shovel 56 of the type shown in fig.6. In this case the pontoon 26 is displaceable in the two directions F_1 and F_2 and has the pumping body 20 firmly secured to one side thereof; the pumping chambers 22 are connected through the connecting hose 32 to the

two halves 56a and 56b of the double shovel 56 in the same way shown in fig.6. The dragging of the pontoon along the said directions takes place by means of the two capstans 74 and 76.

For the dragging of the shovel for the dredging strokes there are provided the ropes 84 and 86 controlled by the capstans 80 and 82 cooperating with the pulleys 88 and 90. The positions of these pulleys are adjusted by means of the ropes 92 and 94 operated by the capstans 96,98 and 100,102 and engaging pulleys 104,106 and 108 for the rope 92 and 110,112 and 114 for the rope 94 secured to anchoring bodies 116,118 and 120,122.

By adjusting for example the dragging capstan 74 the pontoon is displaced at the same speed as the dragging speed of the part 56a of the shovel 56 which is controlled by the capstan 80; meanwhile the capstans 82 and 76 are maintained in a rest condition.

At the end of the dredging stroke the dredging direction is inverted after the gate valve 62a has been closed and the gate valve 62b has been opened, and upon the shovel 56 has been dispalced sidewise by a space corresponding to the width thereof by means of the capstans 96,98,100 and 102 and the pulleys 88 and 90, the dredging stroke in the opposite direction F_2 is carried out.

In this case the part 56b of the dredging shovel 56 is operative.

Turning now to fig.11, the problem is solved of the dredging at very high depth as in the case of oil drilling platforms or sealines, wherein the material to be dredged consists of mud, sand and gravel resulting from the drilling operations. In this case the said connecting hose (indicated by the reference 32 in the previously discussed figures) has to be guided along the soundings to be dredged and is provided with a suction head or mouth for which the main requisite to be fulfilled is that the percentage of solids in the mixture being pumped must be not very high and the flow rate thereof must be such that no interruption of the flow of dredged mixture to the pumping cylinders might occur.

The pumping cylinders shall be suspended at relevant distances from the sounding in order to take advantage of the counterpressure originating from the difference of height between the water level and the position taken by the pumping body.

Since the inlet flow rate of the dredged material is proportional to the depth of the pumping body and since to get a determined flow rate the hose diameter must be of a suitable size in order to ensure a constant flow rate by which the solid particles are raised along the connecting hose without interruption, it is necessary that the suction head is properly shaped and sized to provide the suction of a percentage of solid particles neither too low (the operation in this case being not economically feasible) nor too high (in this case the risk exists of the clogging of the connecting hose and/or of the pumping cylindrical chambers).

To this end the suction head has a shape such as to prevent it from being readily digged into the mass of drilling residues to be removed (since in this case the percentage of solids in the dredged mixture would increase too much), and is of variable area in order to ensure the constant flow rate of the dredged mixture and thus to be adjustable to varying conditions of the soundings being dredged and to varying depths.

In the embodiment shown in fig. 11, an oil drilling platform 124 is shown whilst the reference 126 indicates the heap oh drilling residues, in form of mud, sand and gravel to be removed.

To this end the pumping body 20 is suspended at a suitable depth by means of the crane 128 and the pumping cylinders thereof are connected to the hose ending with a suction head 130 having the above stated features.Of course the hose 32 may be of the previously stated type, i.c. it may consist of connectable lengths, or have a telescopic structure.

In fig.12 the pump 20 comprising the pumping cylinders 22 is connected by the connecting hose 32 to the suction head 130 comprising a flap valve 132 controlling the inlet area of the head 130. The flap valve 132 is controlled by means of a piston assembly 134, remotely controlled and operated either pneumatically or oleodynamically.

Fig.13 shows another embodiment of the apparatus of the invention for use at very high depth such as those involved in the dredging of muddy, sandy or gravel residues of oil drilling or in the laying down of sealines.

In this case the pumping body is modified so as to operate at a reduced pressure but at the same time permits the use of the connecting hose by which the access to difficult or dangerous areas is made possible (see fig. 14).

In this case the cylinders of the pumping body are positioned at different depths and instead of operating in parallel are serially connected, whereby the lowest cylinder fulfills the duty of conveying the dredged mixture to the intermediate cylinder and so on.

For example in the case of three pumping cilinders positioned at three different heights, namely 150 mt, 100 mt and 50 mt, the flow rate of the dredged mixture is reduced to one third of the flow rate attainable with three pumping cylinders of the normal submersed pump of this type, but the operating pressures for each pumping cylinder are also reduced to one third with the self evident advantages.

Otherwise stated in this way this type of submersed pump can be used at very high depths which would not be possible with a normal pump if reasonable weights and mechanical strength of the pumping body are to be taken into consideration.

Of course the number of cylinders serially positioned has no limit it being selected depending on the depth of the sounding to be dredged and on the characteristics of the material to be dredged.

Referring now to fig 13, there are shown two pumping cylinders 136 and 138, the lowest one being provided with the connecting hose of the present invention (not shown) in turn provided with the suction head.

Reference 140 indicates a distributor of compressed air, preferably positioned aboard of the supporting pontoon, and connected by the lines 142 and 144 to the pumping cylinder 136 and 138 respectively.

The inlet side of each pumping cylinder 136 and 138 is provided with a check valve 146 and 148 suitably remotely controlled (for example by the control lines 150 and 152).

References 154 and 156 indicate the delivery or discharge pipes of each pumping cylinder (the pipe 154 being at the same time the inlet pipe for the upper pumping cylinder 138).

The operation of the plant is as follows.The cylinder 136 is lowered until the suction head is into contact with the sounding to be dredged, the valve 146 being closed. At the same time the pumping cylinder 138 is brought to the desired position, and also the check valve 148 is closed.

At the beginning of the operation the distributor 140 causes the air present within the cylinder 136 to be exhausted to the atmosphere and then the check valve 146 is opened whereby the mixture of water and solid materials enters the cylinder 136 filling it.

At that time the valve 146 is closed and compressed air is fed to the pumping cylinder 136 causing the dredged mixture to flow upwardly along the pipe 154.

Meanwhile the upper cylinder 138 has been depleted of air and the valve 148 is opened permitting the mixture delivered from the cylinder 136 to fill it.

At that time the valve 148 is closed and compressed air is fed to the cylinder 138 to discharge the mixture present therein through the pipe 156.

At the same time the filling of the lowest cylinder 136 occurred in the same manner as above described, whereby the operation shall be immediately repeated with the cylinder 138 and so on.

Fig.14 illustrates in a greater detail the embodiment in which the lowest cylinder is connected by a connecting hose 32 to a suction head 130, although in some cases depending on the characteristics of the job, the connecting hose may be omitted.

CLAIMS

1. Dredging apparatus, particularly for the dredging o0f submersed soundings of difficult and dangerous acces, of the type comprising a submersed pump body consisting of at least two pumping chambers adapted to be alternatively and periodically put into communication, through a distributor, with a source of compressed air, each chamber being provided both with a duct for the inlet of a mixture of water and dredged material, the mixture entering the chamber owing to the hydrostatic load acting on the submersed pump body, and with a duct for the outlet of said mixture under the action of the compressed air, characterized in that the said inlet ducts of all the pumping chambers are connected to only one suction hose of variable and adjustable length, said hose being fitted at the free end with a suction head.

2. Dredging apparatus according to claim 1, characterized in that said suction hose consists of a number of hose lengths connectable to each other.

3. Dredging apparatus according to claim 1, characterized in that said suction hose consists of lenghts connectable to each other in a telescopic manner.

4. Dredging apparatus, according to claim 3, characterized in that the telescopic adjustment of said lengths is oleodynamically, hydraulically or pneumatically controlled.

5. Dredging apparatus according to claim 1, characterized in that said suction head has a variable inlet opening the area of which is variable by controlled valve means.

6. Dredging apparatus according to claim 5, characterized in that said controlled valve means consist of a remotely controlled flap valve.

7. Dredging apparatus according to clòaim 1, characterized in that said suction head is in form of a dredging shovel, displaceable along the sounding being dredged, the inlet opening of said shovel being provided with a size screening grid.

8. Dredging apparatus, according to claim 7, characterized in that said dredging shovel is a double shovel, each suction grid opening of which is operative for a dredging direction of said shovel, each suction grid opening of said double shovel being into communication through a gate valve and a connecting duct with said suction hose.

9. Dredging apparatus according to claim 1, characterized in thatsaid suction hose is provided at at least one position along its length with a fitting for the feeding in of a water pressure stream cocurrent with respect to the flow direction of said mixture of water and dredgted material being discharged from a pumping chamber.

10 Dredging apparatus according to claim1, characterized in that a predetermined vacuum is generated in the pumping chambers downstream of said air pressure distributor.

11. Dredging apparatus according to claim 1, characterized in that said pump body is

mounted to a pontoon provided with one or more horizontal arms hinged to the pontoon adjustably movable to have the suction grid shovel dragged along the sounding being dredged.

12. Dredging apparatus according to claim 11, characterized in that said at least one horizontal arm is of telescopic type.

13. Dredging apparatus substantially as hereinbefore described with reference to any of the accompanying drawings.

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Databases (see over)

(i) UK Patent Office

(ii) Online Database: WPI

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Documents considered relevant following a search in respect of claims

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2112078 A (AMTEC DEVELOPMENT) - whole document	1,3.
Y	US 3958346 A (FALDI) - whole document	1,3.
Y	US 4361973 A (IMHOFF) et al whole document	1,3.
Y	EP 0034289 A1 (SCHUTTGUTFORDERTECHNIK)	1,3.
A	GB 1390982 A (FALDI)	1.

SF2(p)

Category	Identity of document and relevant passages	Relevant to claim(s)

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